PRINT DATE: 06/28/07

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 05-3-12602 -X

SUBSYSTEM NAME: DISPLAYS & CONTROLS

REVISION: 1 06/27/97

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: D&C PANEL F6	V070-730403
LRU	: D&C PANEL F8	V070-730404
LRU	: PILOT DISPLAY UNIT (PDU)	MC409-0096-00X1

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
PILOT DISPLAY UNIT (PDU)

REFERENCE DESIGNATORS: 34V73A6A9
34V73A8A9

QUANTITY OF LIKE ITEMS: 2
TWO. PDU 1 AND 2

FUNCTION:
PROCESSES ANALOG SIGNALS FROM THE HEAD UP DISPLAY ELECTRONICS (HUDE) UNIT AND PROVIDES A CRITICAL FLIGHT MEASUREMENT DISPLAY SUPERIMPOSED ON THE OUT-THE-WINDOW VIEW.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
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REVISION#: 1 08/27/97

SUBSYSTEM NAME: DISPLAYS & CONTROLS
LRU: D&C PANEL F6, F8
ITEM NAME: PDU

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
ERRONEOUS OUTPUT. DISPLAY IS INTERMITTENT OR DISTORTED.

MISSION PHASE:
PL PRE-LAUNCH
LO LIFT-OFF
OO ON-ORBIT
DO DE-ORBIT
LS LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
VIBRATION, SHOCK, PIECE PART FAILURE, CONTAMINATION, ERRONEOUS INPUT.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
ERRONEOUS DISPLAY ON AFFECTED PDU.

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(B) INTERFACING SUBSYSTEM(S):
NO EFFECT.

(C) MISSION:
NO EFFECT.

(D) CREW, VEHICLE, AND ELEMENT(S):
DETECT ERRONEOUS INDICATIONS OF CRITICAL FLIGHT DATA AND USE BACK UP/ALTERNATE DISPLAYS.

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE (AFTER FAILURE OF THE PILOT'S HEAD UP DISPLAYS (HUD) DUE TO UNDETECTED ERRONEOUS OUTPUT ON THE COMMANDER (CDR) HUD DURING THE FINAL PHASE OF LANDING. SPECIFICALLY, IF THE CDR HUD ERRONEOUS OUTPUT FAILURE OCCURS WHLE TRANSITIONING FROM THE PRECISION APPROACH PATH INDICATORS (PAPI'S) ON THE OUTER GLIDESLOPE (OGS) TO THE BALLBAR ON THE INNER GLIDESLOPE (IGS), THERE IS INSUFFICIENT TIME TO DETECT AND CORRECT FOR ENERGY LOSS DUE TO INCORRECT GUIDANCE INFORMATION.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)):

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
ALTHOUGH THE CRITICALITY REMAINS UNCHANGED AFTER WORKAROUNDS CONSIDERATION (ALLOWED PER CR S050107W), THEY ARE PROVIDING FAULT TOLERANCE TO THE SYSTEM.

1. CDR HUD - VIA CROSSCHECK FROM THE OTHER GOOD HUD AND DEDICATED DISPLAYS, THE CDR WILL DETERMINE THAT THE HUD IS FAILED AND POWER IT OFF. THE CDR WILL TRANSITION TO THE DEDICATED DISPLAYS AND OUT-THE-WINDOW VIEW FOR CRITICAL LANDING DATA AND CUES.
2. PLT HUD - VIA CROSSCHECK FROM THE OTHER GOOD HUD AND DEDICATED DISPLAYS, THE PLT WILL DETERMINE THAT THE HUD IS FAILED AND POWER IT OFF. THE PLT WILL THEN USE DEDICATED DISPLAY DATA TO PERFORM STANDARD CROSSCHECKS FOR LANDING.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE HUD CONSISTS OF TWO LRU'S, THE HUD ELECTRONICS UNIT (HUDE) AND THE PILOT DISPLAY UNIT (PDU). THE HUDE PROVIDES OUTPUT SIGNALS CAPABLE OF DRIVING THE PDU TO DISPLAY VEHICLE ATTITUDE INFORMATION, AIR DATA

INFORMATION, STEERING INDICATIONS AND CERTAIN PILOT CUES. THE PDU IS CAPABLE OF RECEIVING INPUT DATA SIGNALS FROM THE HUDE AND OF USING THESE INPUT SIGNALS TO PROVIDE A DISPLAY SUPERIMPOSED ON THE OUT-OF- WINDOW VIEW. EEE PARTS ARE SELECTED FROM OR IN ACCORDANCE WITH MF0004- 400 (OPPL) REQUIREMENT. UNIT IS DESIGNED TO FLIGHT VIBRATION REQUIREMENTS. THE HUD SHALL HAVE A MINIMUM USEFUL LIFE OF 25,000 HOURS. THIS IS EQUIVALENT TO 100 ORBITAL MISSIONS IN A 10-YEAR PERIOD FROM DATE OF DELIVERY. AVERAGE ORBITAL MISSION DURATION WILL BE 7 DAYS; HOWEVER, HUD DESIGN SHALL NOT PRECLUDE THE CAPABILITY TO EXTEND ORBITAL STAY-TIME UP TO A TOTAL OF 30 DAYS. PREVENTIVE MAINTENANCE, SERVICING, REPAIR, AND REPLACEMENT OF PARTS SHALL BE CONSISTENT WITH THE SELLER'S TRADEOFF RESULTS, AS APPROVED BY THE BUYER. THE MAXIMUM ALLOWABLE RADIAL SYMBOL POSITIONING ERROR, RELATIVE TO THE PDU OPTICS AXIS, AS MEASURED ON THE COMBINING GLASS AND OBSERVED FROM THE DESIGN EYE POSITION, SHALL BE NO GREATER THAN THE FOLLOWING: A. ON OPTICS AXIS (0.8 MR); B. 6 DEGREES RADIAL DEFLECTION (2.0 MR); C. 9 DEGREES RADIAL DEFLECTION (3.2 MR); D. 10 DEGREES RADIAL DEFLECTION (3.8 MR). FRAME TO FRAME JITTER SHALL NOT EXCEED 0.25 MR.

(B) TEST:
ACCEPTANCE REQUIREMENTS INCLUDE:
EXAMINATION OF PRODUCT
INSULATION RESISTANCE TEST
PERFORMANCE
ACCEPTANCE THERMAL TEST
ACCEPTANCE VIBRATION TEST

AVT

20 TO 80 HZ	INCREASING AT 3 DB/OCTAVE TO 0.04 G SQUARED/HZ AT 80 HZ
80 TO 350 HZ	CONSTANT AT 0.04 G SQUARED/HZ
350 TO 2000 HZ	DECREASING AT 3 DB/OCTAVE TO 0.04 G SQUARED/HZ AT 350 HZ

ATT

THE PDU SHALL BE THERMAL CYCLED FROM 70 DEG. F TO PLUS 120 F TO PLUS 20 DEG. F TO PLUS 120 DEG. F TO 70 DEG. F WITH CONTINUITY MONITORED THROUGHOUT. RATE OF CHANGE SHALL NOT EXCEED 240 DEG. F PER HOUR, NOR LESS THAN 60 DEG. F PER HOUR. DWELL AT EACH LIMIT TEMPERATURE SHALL BE THE TIME REQUIRED TO STABILIZE
THE UNIT'S TEMPERATURE PLUS THE TIME REQUIRED TO CONDUCT ANY PERFORMANCE TEST; HOWEVER THE MINIMUM TIME SHALL NOT BE LESS THAN 1 HOUR. INPUTS SHALL BE PROVIDED TO ALL FUNCTIONS SO THEY ARE ACTIVE DURING THERMAL TESTS.

QUALIFICATION TESTS INCLUDE:

ACCEPTANCE TEST

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EMC
TOUCH TEMPERATURE
CABIN ATMOSPHERE
THERMAL CYCLE
VIBRATION
THERMAL VACUUM
OPERATING LIFE
SHOCK
POWER
MAGNETIC EFFECTS
SYMBOL BRIGHTNESS UNIFORMITY
SYMBOL SIZE AND POSITIONING
KICKLOAD
IMPACT

QAVT

20 TO 80 HZ	INCREASING AT 3 DB/OCTAVE TO 0.067 G SQUARED/HZ AT 80 HZ
80 TO 350 HZ	CONSTANT AT 0.067 G SQUARED/HZ
350 TO 2000 HZ	DECREASING AT 3 DB/OCTAVE TO 0.067 G SQUARED/HZ AT 350 HZ
DURATION	FIVE TIMES AVT MINUTES PER AXIS

QTT

THE PDU SHALL BE THERMALLY CYCLED FIVE TIMES FROM: PLUS 70 DEG. F TO PLUS 130 DEG. F TO PLUS 10 DEG. F TO PLUS 130 DEG. F TO PLUS 70. RATE OF CHANGE SHALL NOT EXCEED 240 DEG. F PER HOUR. TIME DURATION AT EACH EXTREME TEMPERATURE SHALL BE SUFFICIENT TO ACHIEVE THERMAL STABILIZATION PLUS THE TIME REQUIRED TO CONDUCT FUNCTIONAL TESTS, BUT SHALL NOT BE LESS THAN 2 HOURS.

ACCELERATION
PLUS AND MINUS 5 G'S IN ALL MAJOR AXES.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD. THE OMRSD DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE. IF THERE IS ANY DISCREPANCY BETWEEN THE GROUND TESTING DATA PROVIDED BELOW AND THE OMRSD, THE OMRSD IS THE MORE ACCURATE SOURCE OF THE DATA.

G9 TURNAROUND VERIFIES PROPER OPERATION OF HUD UNITS.

(C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION PERFORMS A VISUAL EXAMINATION OF ALL INCOMING PARTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

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CONTAMINATION CONTROL
QC VERIFIES THAT REQUIRED PROCEDURES AND SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL.

ASSEMBLY/INSTALLATION
DETAILED INSPECTION IS PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY.

CRITICAL PROCESSES
ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION I.E.; WAVE SOLDERING, CONFORMAL COATING, ADHESIVE BONDING, CHEM FILM, PAINTING, ANODIZING, HEAT TREAT, STRIPPING, CRIMPING, SWAGGING AND TORQUE VALUES.

TESTING
ALL PARTS OF THE ATP ARE OBSERVED AND VERIFIED BY QC.

HANDLING/PACKAGING
IN-PROCESS OPERATIONS ARE VERIFIED BY QC TO PROTECT PARTS AND PRECLUDE MISHANDLING. PARTS PACKAGING IS VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

(E) OPERATIONAL USE:
CREW MAY UTILIZE REDUNDANT HUD AND OTHER DEDICATED DISPLAYS, AS AVAILABLE AFTER THE FIRST FAILURE IS RECOGNIZED..

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kimura 8/28/97
EDITORIALLY APPROVED	: JSC	: Sam Searcy 9/02/97
TECHNICAL APPROVAL	: VIA APROVAL FORM	: 96-CIL-024_05-3